Top Secret

16

[redacted]

S 32410

DIRECTORATE OF INTELLIGENCE

Declass Review by NIMA/DOD

Imagery Analysis Report

Ust-Kamenogorsk Titanium-Magnesium Combine

USSR

Top Secret

25X1

25X1

DATE NOV 1967
COPY 8
PAGES 12

Approved For Release 2002/11/13 : CIA-RDP79T00919A000300160001-2

UST-KAMENOGORSK TITANIUM-MAGNESIUM COMBINE
USSR

SUMMARY

This is the first detailed study of the Ust-Kamenogorsk Titanium-Magnesium Combine. An analysis of photography reveals continued construction [redacted] when this plant was seen complete and the production facilities were first observed in operation. These facilities appeared highly active when last seen on [redacted] photography. The thermal power plant within the combine area was first seen in operation [redacted] 25X1 25X1 25X1

Of the three known Soviet titanium plants, this plant is the largest. The facilities tentatively identified include both an electrolytic cell building and a Kroll reduction building for titanium production and also an electrolytic cell building for magnesium production. The titanium electrolytic cell building is the first of its type known to exist in the world and was complete [redacted] Previously, titanium production on an industrial scale was limited to the Kroll process. 25X1

CONTENTS

Illustrations

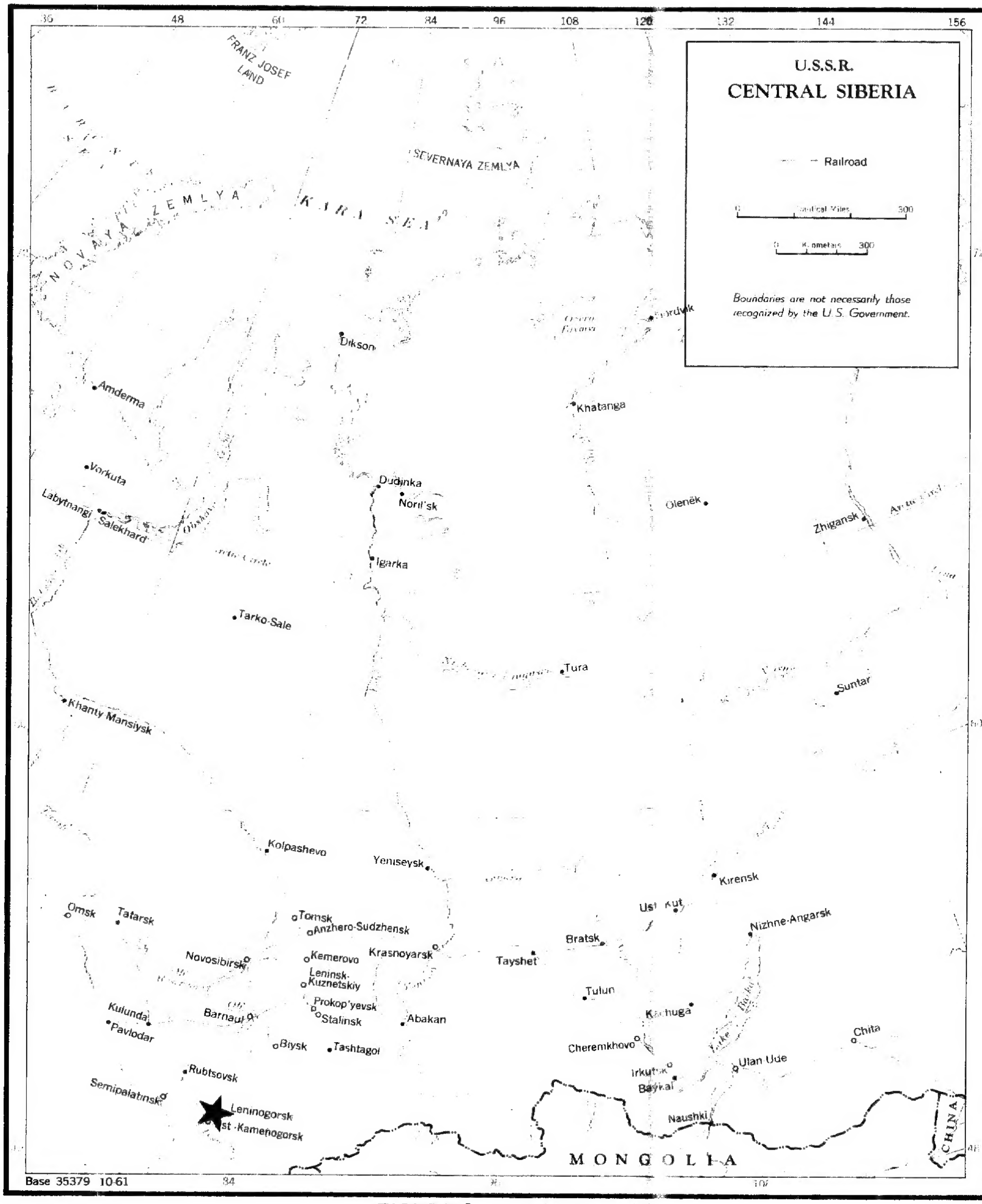


FIGURE 1. LOCATION MAP

INTRODUCTION

The Ust-Kamenogorsk Titanium-Magnesium Combine is located 7.2 nautical miles (nm) northeast of Ust-Kamenogorsk, USSR, at 50-02N 082-45E (Figure 1).

This plant was studied using all available photographic coverage through [redacted] The purpose of the report is to identify, measure, and provide a chronological analysis of the facilities at this plant. Building identifications are based on information obtained from an on-site examination of the facilities at a US titanium plant [redacted] and on information obtained from various collateral reports. 1/ 2/ 5/ Many of the facilities are tentatively identified due to the lack of large-scale photographic coverage and because the configuration of a titanium plant is not limited to a distinctive design.

25X1 25X1

All measurements have been made by the NPIC Technical Intelligence Division with the exception of those indicated by an asterisk (*), which were made by the Imagery Analysis Service project analyst. The NPIC/TID measurements are considered to be accurate within [redacted] whichever is greater.

25X1

DISCUSSION

This plant is rail and road served and occupies an irregularly shaped, wall-secured area of approximately 230 acres (Figure 2). The plant consists of seven distinct areas which are designated A through G in this report. These include four production components: a Titanium Production Area (A), a Possible Carnallite Ore Processing Area (B), a Probable Chlorine Production Facility (D), and a Probable Magnesium Production Area (E). In addition, the plant contains a Storage Area (C), a Thermal Power Plant (F), and an Administration and Support Area (G); two waste ponds are located outside the plant area. The descriptions and dimensions of the major structures in the plant are shown in Figure 3. All production facilities were first seen in operation [redacted] except the thermal power plant which was first observed in operation [redacted] The following discussion of the production and power facilities describes the flow of materials through the plant.

25X1 25X1

TITANIUM PRODUCTION AREA

Probable Titanium Tetrachloride Facility

This facility (Area A, Item 2) probably receives a titanium-ore concentrate from the mining site. The ore is combined with coke and chlorine gas in an exothermic reaction to produce gaseous titanium tetrachloride and carbon dioxide. The gaseous titanium tetrachloride and the chlorinated vapors of associated impurities are condensed into a liquid and separated by fractional distillation. The pure liquid titanium tetrachloride is then pumped through a pipeline (Area A, Item 4) to the probable Kroll reduction building.

Probable Kroll Reduction Building

In the probable Kroll reduction building (Area A, Item 5), titanium tetrachloride and magnesium metal combine in an exothermic reaction to produce titanium sponge and magnesium chloride. This reaction takes place in an atmosphere of inert gas to prevent hydrogen and oxygen contamination. The magnesium chloride is tapped off and sent to the probable magnesium electrolytic cell building (Area E, Item 1) where it is separated into magnesium metal and chlorine gas. The titanium sponge remains in the crucible until it has cooled to room temperature. Once cooled, the sponge hardens and must be drilled from the crucible. This operation is extremely dusty and is therefore done in a separate section of the Kroll reduction building. The high dust-covered section (Area A, Item 6) on the east end of the Kroll reduction building appears to house this operation.

After being drilled out of the crucible, the resulting impure titanium sponge is transported to the adjacent probable sponge purification building (Area A, Item 7) where it is heated to drive off the last traces of magnesium chloride and magnesium metal. The titanium sponge is then washed and dried before being sent to the probable electroslag melting furnace buildings.

Probable Titanium Electrolytic Cell Building

The Soviets have reported that this plant uses an electrolytic salt bath process to produce titanium in addition to the Kroll process. 2/ The long rectangular building (Area A, Item 13) on the south side of the plant is an electrolytic building probably producing impure titanium. This building is connected by two busbars to a rectifier building (Area A, Item 14), where alternating current is converted to direct current for use in the electrolytic cells.

Relatively little information is available on titanium production through electrolysis, but the process normally consists of introducing titanium tetrachloride into an electrolytic cell containing a salt bath. Direct current is allowed to pass through the solution which breaks down titanium tetrachloride with titanium being drawn to the cell cathode where it is tapped off. This impure titanium is then allowed to cool in an inert atmosphere before being sent to an electroslag melting furnace for further processing.

Probable Electroslag Melting Furance Buildings

Unlike US plants which use vacuum-arc furnaces to reduce titanium sponge to titanium metal, the USSR uses electroslag melting furnaces. The two buildings on the west side of the plant (Area A, Items 9 and 11) probably house these furnaces. They are served by power lines from a gallery (Area A, Item 16) that passes on the east side of Building 11. These buildings are connected by a passageway to a storage building (Area A, Item 10) that probably stores titanium sponge and finished titanium metal. The raised portion on the west end of the passageway probably houses a drop forge used to compress alloyed titanium sponge into consumable electrodes for use in the electroslag melting furnaces.

In this process the consumable titanium sponge electrodes are converted into titanium metal ingots by melting in an electroslag melting furnace. First, two small ingots are obtained from two separate melts of consumable sponge electrodes. The two small ingots are then welded together and melted a second time in a larger electroslag furnace. 4/ The large ingot obtained from this melt may be heated, forged into slabs, and stored in Building 10.

Electroslag melting is sometimes a dangerous operation. If a hole develops in the copper crucible where the titanium is being melted, an explosion will occur because molten metal will come in contact with the crucible cooling water. Safety precautions taken at a US plant include: encasing the furnace in a steel shell, using blast outlet pipes, locating the furnace near the wall of the building and raising a large door on the outside wall while melting is under way. The safety precautions taken at this facility may be a type of blast-deflecting device contained within the protrusions seen on the exterior walls of the furnace buildings. Building 9 has eight of these protrusions, four on either side; and Building 11 has four on the east side.

PROBABLE MAGNESIUM PRODUCTION AREA

This area (Area E) contains a possible magnesia unloading building, eight possible magnesia storage silos, a probable magnesia chlorination facility, a probable magnesium electrolytic cell building, and a storage building. The electrolytic cell building (Area E, Item 1) obtains DC current from a power line gallery (Area A, Item 16) that connects to the rectifier building (Area A, Item 14) and the passageway on the west side of the building. The power lines probably split upon entering the cell building to serve two rows of electrolytic cells. This building functions primarily to regenerate magnesium which is recycled for use in the Kroll reduction furnaces. As was previously mentioned, magnesium chloride is received from the probable Kroll reduction building and separated into magnesium and chlorine.

Because of the loss of some of the magnesium chloride in this process, additional amounts must be produced from magnesia. This is accomplished by pelleting magnesia supplied from the magnesia silos (Area E, Item 3) with peat moss, petroleum coke, and magnesium chloride. The pellets produced in the low end of the chlorinator building (Area E, Item 2) are charged into chlorinators located in the tall section of Item 2 and heated with chlorine. The resulting magnesium chloride is then fed to the electrolytic cell building where it is separated into magnesium and chlorine.

PROBABLE CHLORINE PRODUCTION FACILITY

As has already been discussed, chlorine is used in this plant to produce titanium tetrachloride and magnesium chloride. The large amounts of chlorine needed for these processes are probably produced in the probable chlorine electrolytic cell buildings located in the center of the plant (Area D, Item 1). A probable salt-storage pile (Area D, Item 3), the primary raw material needed, is located near this building. The rectifier section of the building is the small portion in the center, forming the "U" shape of the building.

POSSIBLE CARNALLITE ORE PROCESSING AREA

This plant is reported to be producing potassium fertilizer from carnallite ore. 5/ The ore-processing facilities located within Area B

may be used to process carnallite ore. However, the only identifiable features are a lime kiln (Area B, Item 1) and an ore-crushing and screening building (Area B, Item 2). The process used to produce potassium fertilizer from carnallite may be a secondary process in which the main objective would be to remove the magnesium chloride from the carnallite to produce magnesium metal. 3/ 5/ The lime produced in the lime kiln would then be added to the secondary product, potassium, along with other additives to produce potassium fertilizer.

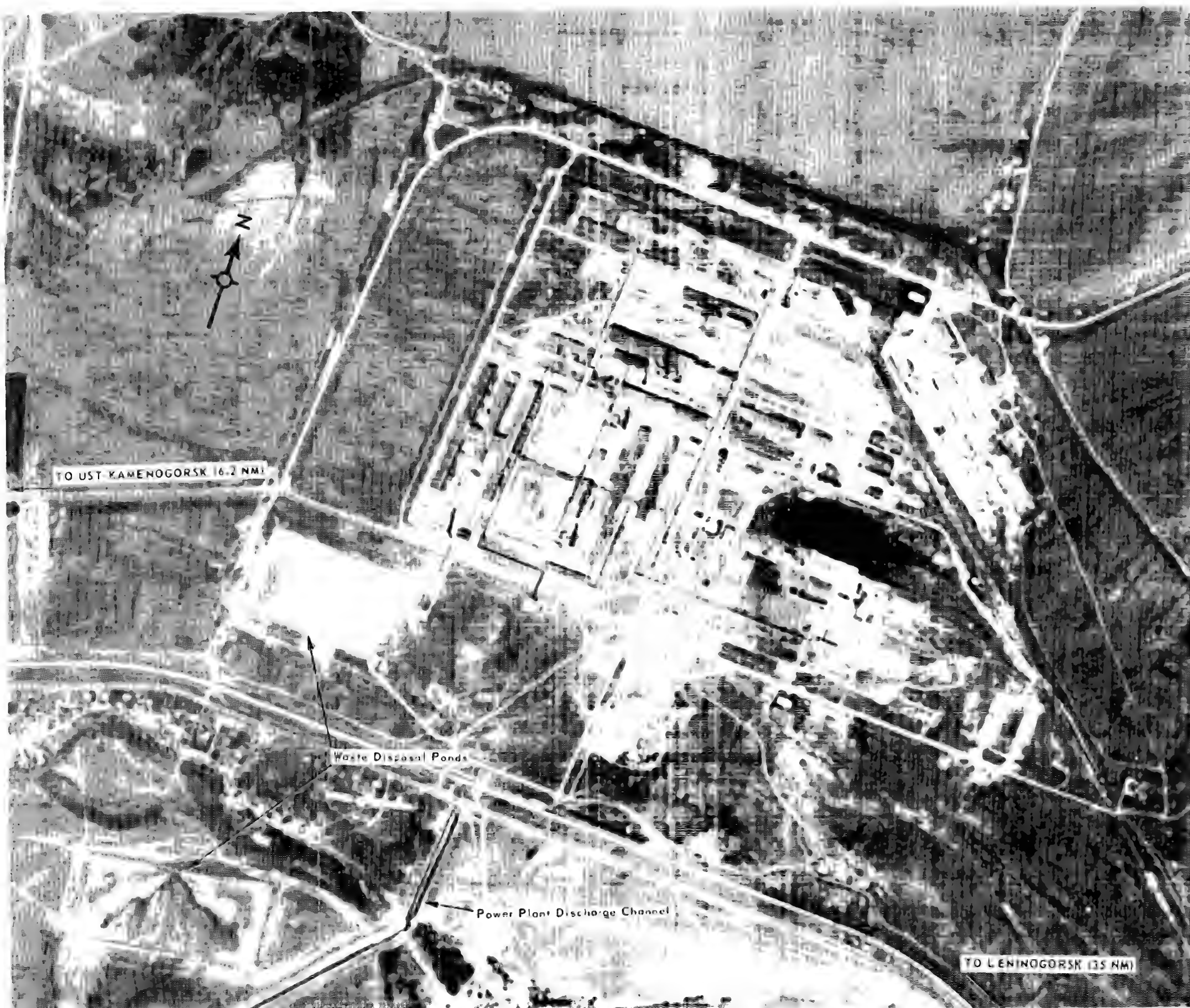
POWER FACILITIES

In addition to generating its own electric power, the combine receives electric power from the Ust-Kamenogorsk Thermal Power Plant (49-49N 082-36E) located 6.2 nm to the southwest. Power lines from this plant can be traced to two transformer substations, one in the northern section of the combine and the other on the south side of the combine (Area A). The power lines from the southern substation enter the rectifier building (Area A, Item 14) and a power line gallery (Area A, Item 16) that runs throughout the plant.

The thermal power plant within the combine (Area F, Item 2) has an adjoining switching building (Area F, Item 3) from which a second power line gallery extends to the rectifier building. This coal-fired power plant is separately secured from the rest of the combine. It was first seen in operation [redacted] 25X1

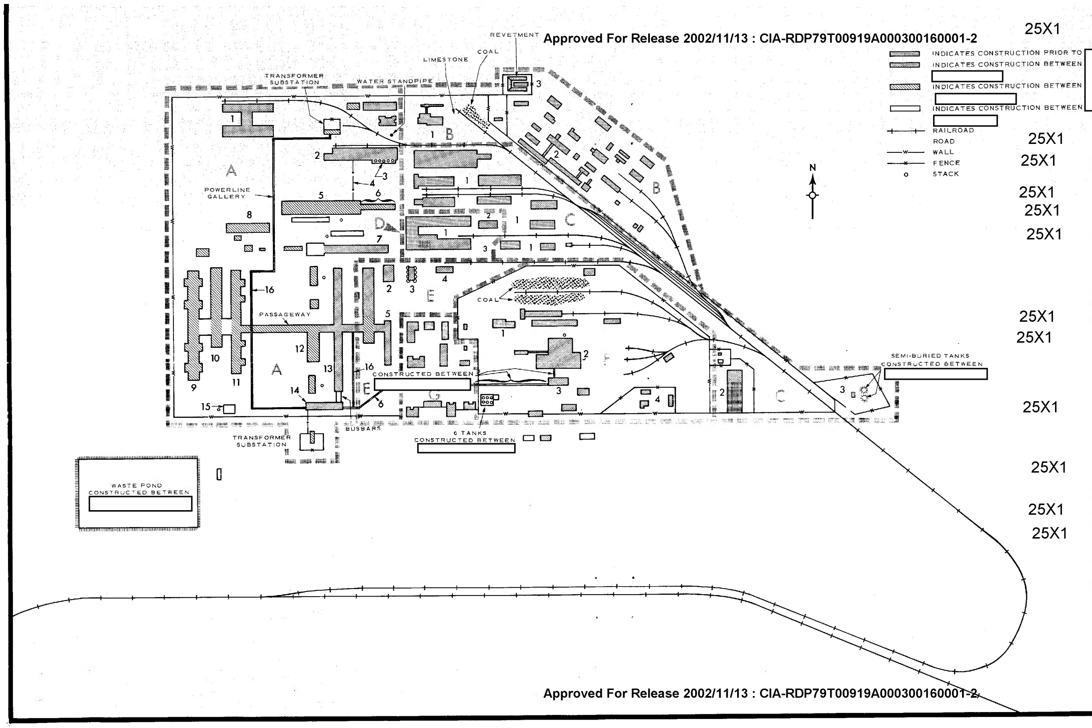
OTHER FACILITIES

Other facilities within the plant area include six administration and five support buildings (Area G), a revetted storage building (Area B, Item 3), nine storage buildings (Area C, Item 1), a vehicle maintenance building (Area C, Item 2), two semiburied tanks with a pumphouse (Area C, Item 3), and a possible compressor building (Area A, Item 8). Two waste disposal ponds are located southwest of the plant area (Figure 2).



25X1
25X1

FIGURE 2. UST-KAMENOGORSK TITANIUM-MAGNESIUM COMBINE,



25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

25X1

ITEM	DESCRIPTION	DIMENSIONS (FT)
AREA A. TITANIUM PRODUCTION AREA		
1	Laboratory	Irregular
2	Probable Titanium Tetrachloride Facility	Irregular
3	Ore Silos (5)	--
4	Pipeline	
5	Probable Kroll Reduction Building	
6	Probable Sponge Drilling Section	
7	Probable Titanium Sponge Purification Building	705 x 55 & 100
8	Possible Compressor Building	330 x 65
9	Probable Electroslag Melting Furnace Building	
10	Storage Building	
11	Probable Electroslag Melting Furnace Building	965 x 70
12	Unidentified Building	240 x 95
13	Probable Titanium Electrolytic Cell Building	
14	Rectifier Building	380 x 50
15	Probable Smoke Precipitation Building	80 x 60*
16	Power Line Gallery	--
AREA B. POSSIBLE CARNALLITE ORE PROCESSING AREA		
1	Lime Kiln	--
2	Ore Crushing Building	--
3	Revetted Storage Building	120 x 50
AREA C. STORAGE AREA		
1	Storage Buildings (9)	Varying
2	Vehicle Maintenance Building	
3	Semi-buried Storage Tanks (2) with Pump House	--
AREA D. PROBABLE CHLORINE PRODUCTION FACILITY		
1	Probable Chlorine Electrolytic Cell Buildings (2)	Irregular
2	Support Building	
3	Probable Salt Storage Area	--
AREA E. PROBABLE MAGNESIUM PRODUCTION AREA		
1	Probable Magnesium Electrolytic Cell Building	680 x 90
2	Probable Chlorination Facility	
3	Possible Magnesia Silos (8)	
4	Possible Magnesia Unloading Building	150 x 35
5	Storage Building	520 x 65
6	Power Line Gallery	--
AREA F. THERMAL POWER PLANT		
1	Coal Preparation Building	145 x 55*
2	Thermal Power Plant	Irregular
3	Switching Building	190 x 50
4	Support Buildings (3)	Varying
AREA G. ADMINISTRATION BUILDINGS (6) AND SUPPORT BUILDINGS (5)		Varying

25X1

REFERENCES

[redacted] 25X1

Maps and Charts

USAF, 2nd RTS. US Air Target Chart, Series 200, Sheet 0239-13HL, Scale 1:200,000, 2nd Edition, January 1963 (SECRET)

Documents

1. CIA. IR-00-B-321/02123-66, Purchase of Soviet Made Titanium Sponge, 3 February 1966 (CONFIDENTIAL)

2. CIA. RR-ER-64-14, Assignment of High Priority to the Soviet Titanium Industry, April 1964 (SECRET)

3. Shabad, T., "Soviet to Open Processing Plant for Titanium and Magnesium," The New York Times, March 10, 1965, page 63 (UNCLASSIFIED)

4. Carmichael, R.L., "Nonferrous Metals and the Chemical Engineer, Part I: Titanium," Chemical Engineering, November 21, 1966, page 109 (UNCLASSIFIED)

5. Yershov, A., "The Wings of Metal," Kazakhstanskaya Pravda, May 24, 1964, page 2 (UNCLASSIFIED)

6. "Iron Curtain Titanium," Chemical Week, September 17, 1966, page 96 (UNCLASSIFIED)

Requirement

C-RR6-84,048

CIA/IAS Project

30428-7

[redacted]

S-	S 3[illegible]0
int/	date
INDEXED	
DD	6-DEC-67
CODED	
CHECKED	
SX	5 Mar. 68
RELEASED	
SB	18/3/68

Top Secret

Approved For Release 2002/11/13 : CIA-RDP79T00919A000300160001-2